Introduction

Syndesmotic instability after malleolar fixation occurs in about 13% of patients with malleolar fractures.1,2 Even though syndesmosis reduction and screw fixation has been the standard treatment of syndesmosis instability after malleolar fixation, there are several significant problems associated with this approach, including screw loosening, breakage, discomfort, reoperation, time to return to weight bearing, and loss of reduction due to early implant removal.6,8,11,14 Recently, an alternative dynamic fixation device, the suture button, has shown promising results. Three systematic reviews of several studies have shown that it has similar or better functional outcomes as well as lower postoperative complication rates, reoperation rates, and earlier return to work.5,11,17 The suture button is placed through an empty hole in the fibular plate where a lateral knot is then made to maintain tension, resulting in fixation that lies against the lateral aspect of the plate. However, during healing, this knot can rotate and fall into the plate hole, resulting in loss of tension in the suture button and loss of stability that leads to syndesmosis widening.

While one-third tubular plates can be used for Weber B fibula fractures, limited contact dynamic compression (LCDCP) plates have been shown to add greater stiffness to a fracture construct, which is especially useful in stabilizing
suprasyndesmotic, Weber C fractures.\textsuperscript{9,15} The primary aim of our case series is to highlight the slippage of suture buttons through an LCDCP hole as a complication of syndesmotic fixation of Weber C malleolar fractures. We then describe and recommend a potential solution to avoid this complication using double-stacked one-third tubular plates instead of LCDCP when using suture button fixation of Weber C fractures.

Methods

The malleolar fracture database of our department from May 2014 to August 2017 was reviewed. We found and present here 3 cases of Weber C fractures with postoperative radiographs showing a slippage of the Tightrope (Arthrex Inc, Naples, FL) suture button through the LCDCP holes over time. We present the clinical data as an illustration and measured the medial clear space (MCS), tibiofibular clear space (TFCS), and distal tibiofibular overlap (DTFO) and computed the largest change in these measurements from the first postoperative follow-up radiographs. We next present from our database 3 cases of Weber C fractures, which did not show any slippage of the suture button when double-stacked one-third tubular plates were used instead of the LCDCP.

Results

Case 1

A healthy 18-year-old gentleman presented to the emergency department and reported left ankle pain after falling while ice skating. Imaging revealed an oblique left distal fibular shaft Weber C fracture with a widened medial clear space. He underwent an operative fixation of the left ankle 10 days later. The fibula was fixed with a lag screw and neutralized with a contoured 3.5-mm 8-hole LCDCP. The syndesmosis was unstable after malleolar fixation and subsequently reduced with a suture button that was passed through the second distal LCDCP hole to the tibia and tightened.

Full weight bearing was started at 5 weeks postoperation. Postoperative routine radiographs were taken at each follow-up appointment, and the radiograph taken at the 6-month follow-up appointment first showed slippage of the suture button through the LCDCP hole. Earlier postoperative radiographs taken at 2 and 5 weeks did not show any evidence of slippage. The patient was followed up for a period of 18 months. The largest changes in MCS, TFCS, and DTFO were 0.8, 2.4, and −1.5 mm, respectively (Table 1). This patient first complained of left ankle pain at 6-month postoperative follow-up but was able to ambulate without any problems. This pain was associated with swelling after running and persisted until the last follow-up but was absent at rest.

Case 2

A 24-year-old woman presented to the emergency department and reported pain in her left foot after falling from a height of 2 m while rock climbing. Imaging revealed a left distal fibula Weber C and left medial malleolar fracture with widening of the MCS. She underwent an operative fixation of the left ankle 4 days later in which the fracture was fixed with a lag screw and neutralization of the fibula was achieved using a 3.5-mm 7-hole LCDCP. The syndesmosis was unstable after malleolar fixation and was subsequently clamped and fixed with a suture button that was passed through the most distal LCDCP hole to the tibia and tightened.

Full weight bearing was started at 10 weeks postoperation. At the 10-week follow-up, the suture button was first observed to have slipped through the LCDCP hole and migrated under the LCDCP over the subsequent follow-up period (Figure 1). This slippage was not evident in prior follow-up radiographs at 2 and 6 weeks postoperation. The patient was followed up for a period of 18 months. The largest changes in MCS, TFCS, and DTFO were 0.8, 0.9, and −3.2 mm, respectively (Table 1). This patient first complained about occasional left ankle swelling after prolonged walking at the 6-month postoperative follow-up but was still able to ambulate well and carry out activities of daily living without any issues. This pain was then associated with swelling after running long distances. At 18-month follow-up, the patient started complaining of pain and tenderness over the medial incision site when standing.

Case 3

A 21-year-old woman presented to the emergency department and reported pain over her left ankle after she twisted it while walking on uneven ground. Imaging revealed a Weber C fracture across the distal fibula shaft and a medial malleolar fracture. She underwent an operative fixation of the left ankle 2 weeks later. The fracture was compressed using a 3.5-mm 7-hole LCDCP. Two cortical screws were used for distal fixation, while 3 cortical screws were used for proximal fixation. Two partial threaded cancellous screws were used to fix the medial malleolar fracture. The

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<tr>
<th>Cases With LCDCP</th>
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<th>MCS increase, mm</th>
<th>0.8</th>
<th>0.8</th>
<th>0.6</th>
<th>0.7</th>
<th>0.081 SD</th>
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<tbody>
<tr>
<td>TFCS increase, mm</td>
<td>2.4</td>
<td>0.9</td>
<td>1.2</td>
<td>1.5</td>
<td>0.798</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>TFO decrease, mm</td>
<td>1.5</td>
<td>3.2</td>
<td>1.9</td>
<td>2.2</td>
<td>0.864</td>
<td></td>
<td></td>
<td></td>
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</tbody>
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Abbreviations: LCDCP, limited contact dynamic compression; MCS, medial clear space; TFCS, tibiofibular clear space; TFO, tibiofibular overlap.
syndesmosis was unstable after malleolar fixation and was then clamped and fixed with a suture button that was passed through the most distal LCDCP hole.

Full weight bearing was started at 6 weeks postoperatively. We first noticed slippage of the suture button through the LCDCP hole at 6 weeks’ follow-up (Figure 2). Earlier radiographs taken at 2 weeks postoperation did not show any evidence of slippage. The patient was followed up for a period of 30 months. The largest changes in MCS, TFCS, and DTFO were 0.6, 1.2, and −1.9 mm, respectively (Table 1). Nevertheless, this patient did not complain of any symptoms or functional problems with her left ankle since the slippage was first observed.

Discussion

LCDCP have been commonly used as an alternative to one-third tubular plates for fixation of distal fibula malleolar fractures because they are thicker and provide more stability. These are used only if the soft tissue allows it and does not result in soft-tissue prominence. However, the profile of the holes in the plate are oblong, deep, and sloped, in contrast to the shallow circular holes of the one-third tubular plate. The oblong-shaped screw holes of the LCDCP hence allow the lateral round-shaped suture button to slip through by horizontal rotation from gradual progressive movements (Figure 3A). This would not be a problem for Weber B fractures, which do not require the use of the LCDCP but a one-third tubular plate. In this case series, we present 3 patients with Weber C fractures who underwent suture button fixation with LCDCP showing evidence of suture button slippage. Two of them (cases 1 and 2) reported symptoms of pain and swelling with prolonged activity after the slippage of the suture button was observed. Even though the number of cases reported here is very limited, this complication should not be taken lightly. Two of 3 of our patients had persistent pain and swelling after the suture button slipped with concomitant radiographic loss of syndesmotic fixation. These patients may experience more clinically significant problems in the long run from syndesmotic widening, which may then require implant removal or syndesmotic reconstruction.

We propose a solution of using 2 one-third tubular plates stacked over each other instead of LCDCP for Weber C fractures to avoid this complication. We found 3 patients (cases 4, 5, and 6) from our database with a Weber C fracture who underwent operative fixation using the suture button and 2 one-third tubular plates that were stacked over each other and placed on the fibula. The suture button was passed through one of the holes of the tubular plates and tightened similarly to the 3 patients who
used the LCDCP. These patients were followed up over a period of 6, 12, and 33 months, respectively. During this time, there was no slippage of the suture button through the tubular plate holes, as evidenced by the radiographs at the first and latest postoperative follow-ups (Figure 4). The mean increases in MCS and TFCS were −0.2 and 1.8 mm, respectively, while the mean decrease in TFO was 1.5 mm (Table 2).

This method effectively avoided slippage of the suture button through the screw hole of the plate used in the fixation of Weber C fractures. As the holes in the one-third tubular plates are less oblong and shallower compared with the LCDCP, the suture button is less likely to migrate within the plate hole, even if the button becomes rotated horizontally from repeated micromotion (Figure 3B). The downside of using a one-third tubular plate is the lower profile of 1.0-mm compared with 3.5-mm thickness of the LCDCP. This means that the stability conferred by a one-third tubular plate to a fracture site is much more limited than an LCDCP. However, using 2 one-third tubular plates as proposed in this article would increase its overall strength, and we believe it is adequate to stabilize Weber C fractures. Other alternative solutions to be considered include the use of half tubular plates that are thicker than one-third tubular plates but have round holes, the use of syndesmotic suture systems that interface directly in a stable fashion with the plate hole so that migration cannot occur, and the use of a syndesmotic screw rather than a suture button if the fibula plate is already in place.

Unlike screw fixation, suture button fixation allows some degree of physiologic micromovement between the tibia and the fibula while maintaining the reduction.7,10 However, complications have been reported in the literature. Degroot et al3 showed that suture button fixation can

![Figure 3.](image.png) Photo showing the Tightrope button going through (A) the oblong-shaped hole of the limited contact dynamic compression plate but not (B) the hole of the one-third tubular plate.

![Figure 4.](image.png) Ankle radiographs of 2 patients showing no slippage of Tightrope button (white arrow) through the double-stacked one-third tubular plate at the first and latest follow-up; case 4: (A) 2 weeks, (B) 6 months; case 6: (C) 2 weeks, (D) 33 months.

<table>
<thead>
<tr>
<th>Cases With Double-Stacked One-Third Tubular</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCS increase, mm</td>
<td>−0.9</td>
<td>0.6</td>
<td>−0.3</td>
<td>−0.2</td>
<td>0.744</td>
</tr>
<tr>
<td>TFCS increase, mm</td>
<td>1.6</td>
<td>1.8</td>
<td>1.8</td>
<td>1.8</td>
<td>0.110</td>
</tr>
<tr>
<td>TFO decrease, mm</td>
<td>−0.1</td>
<td>0</td>
<td>4.5</td>
<td>1.5</td>
<td>2.627</td>
</tr>
</tbody>
</table>

Abbreviations: MCS, medial clear space; TFCS, tibiofibular clear space; TFO, tibiofibular overlap.
cause osteolysis, enlargement of the tibia drill hole, and device subsidence, while Welck and Ray\textsuperscript{16} reported tendon entrapment from the medial button. Suture button device removal due to discomfort and soft-tissue irritation was also reported in 6 patients by Seyhan et al.\textsuperscript{12} A case report by Hong et al\textsuperscript{4} cautioned against using a suture button together with an LCDCP because of the risk of osteomyelitis and slippage of the suture button through the plate hole. However, it is not clear if this slippage of the suture button was a result of the infection. In this case series, we report the slippage of a suture button when used with LCDCP for Weber C fractures as a clear complication of suture fixation in the absence of any infection.

In conclusion, even though suture button fixation provides a promising alternative to screw fixation in syndesmotic diastasis, it is a relatively new method with possible complications yet to be reported. The potential slippage of the suture button through the LCDCP screw hole as a postoperative complication should be taken into consideration. One viable alternative to avoid slippage of the button is the use of double-stacked one-third tubular plates instead of the LCDCP in suture button fixation of Weber C fractures.

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\textbf{References}